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Condition and development of the cogeneration facilities based on autoproduction investment model in Turkey

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Abstract

Turkey, with its young population and growing energy demand per person, its fast growing urbanization, and its economic development, has been one of the fast growing power markets of the world for the last 20 years. It is expected that the demand for electric energy in Turkey will be 294 billion kWh by the year 2010 and 556 billion kWh by the year 2020. Turkey's electric energy demand is growing 7% yearly. Because a substantial amount of Turkey's energy need has been met by cogeneration facilities in recent years. Cogeneration facilities have an important role in Turkey's energy strategy. While there were only four cogeneration facilities and the total capacity of them was 30 MW_e in 1994, in 1999, 10.6% of total electric production was produced by these facilities. In accordance with the governmental decree numbered 85/9799, cogeneration is the technology which produces electricity and heat synchronously and autoproduction is the name of the firm which was founded for the purpose of producing electricity and heat. In this study, the development of autoproduction facilities in Turkey, which are the most convenient legal investment model for cogeneration investors, has been investigated.

Keywords: Turkey; Autoproduction; Cogeneration

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Contents

1. Introduction

At this time, when world population is growing fast, energy needs to grow fast too. Because of the fast growing energy need, limited sources of fossil fuel made the subject of producing quality energy and productive usage of it an important point, especially in Turkey, and in most other developing countries. In productive consumption of energy, cogeneration (combined production of heat and power) takes priority in the future, inspiring technology. Cogeneration systems are the technologies that produce heat and power and reduce primary energy consumption. In other words, it is a technology that uses energy in a productive way [1,2,3]. The biggest benefit that cogeneration technology provides is steady energy consumption. Cogeneration is an effective energy using method in which heat and power are produced from the primary energy sources such as coal, petroleum, natural gas, biomass etc. Cogeneration systems provide a higher thermal output and a decrease in energy cost, increasing stability in energy production and confidence in energy purchasing. Cogeneration systems provide fringe benefits such as declining fuel consumption and, as a result, decreasing CO_2 emissions.

2. Legal regulations in the energy market

Law 3096, published in the Official Gazette on 19 November 1984, and numbered as 18610, regulates electricity production, transmission, distribution, trade and the assignment of national and foreign firms, except the Turkish Electricity Institution, which is subject to private law.

There are five valid (in force) investment models in Turkey: (a) build operate and transfer project; (b) build own operate projects; (c) autoproduction: (d) transferring of production: (e) conventional tendering systems by Turkish Electricity Generation and Transmission Corporation (TEAS).

Autoproduction means electricity production in one's own facilities through the direction of industrial objectives. Cogeneration is the name of the technology chosen by autoproduction system owners (producers) during the establishment of their own systems, which produce electricity and heat together. The regulations and

their contents related to autoproduction and published in Turkey are described as follows.

Regulation 85/9799, published in the Official Gazette on 4 September 1995 and numbered as 18858: this consists of permission and authorization of the autoproduction owners (individuals and institutions) who establish electricity production facilities and produce electricity for meeting their own needs and requirements for preparing feasibility reports.

Regulation 96/8007, published in the Official Gazette on 17 April 1996 and numbered as 22614: this consists of the regulations related to 'who will be authorized', 'over production and its selling price', 'transmission and distribution cost of produced energy to other facilities'.

Regulation 97/9670, published in the Official Gazette on 2 September 1997 and numbered as 23068: this consists of regulations related to housing development projects, over 5000 houses, hospitals, compulsory usage of waste heat and steam, waste energy sales, fuel usage and trade terms, and the rights of autoproduction firms.

3. Development of autoproduction facilities

Because most of the electricity consumers are also heat consumers, producing both of these needs together using the same sources and equipment has alowed the achievement of the highest cycling productivity. These systems, which save a lot of energy, are becoming preferred by autoproduction investors. Autoproduction systems make the electric energy as a marketable good in open competition. With autoproduction systems, the objectives of providing competition for increasing productivity and reducing cost, setting the cost reflective prices for providing the continuity of the energy sectors financially, increasing good and service quality, providing national and foreign firm entrance into the energy market, by making investment decisions on the free market providing demand security, are reached [4]. By the end of 2001, Turkey's total autoproduction capacity had reached 3200 MW. Currently, a 420 MW capacity facility is under construction, and 26 small sized autoproduction systems were approved. In addition, approval by authorized institutions of 19 autoproduction facilities is expected. Fig. 1 shows the last 10-yr improvement of autoproduction [4,5]. Fig. 2 shows the estimated improvement of autoproduction between 2002 and 2010. While total electricity production capacity between the period 1999 and 2005 is expected to rise by 53%, autoproduction is expected to rise by 321%. The scattering of autoproduction in 2000 according to regions is shown in Table 1 [3]. As shown in Table 1, 75% of autoproduction is in the Aegean and Marmara regions where industrialization is intensive.

Fuel is equally important as the current condition of electricity for the energy investors in our country. The price of the main fuel used by autoproduction power plants, which produce heat and electricity by using cogeneration technology is very important. During feasibility, possible changes in fuel prices are reviewed in consideration of the national balances and tendencies [6]. The distribution of autopro-

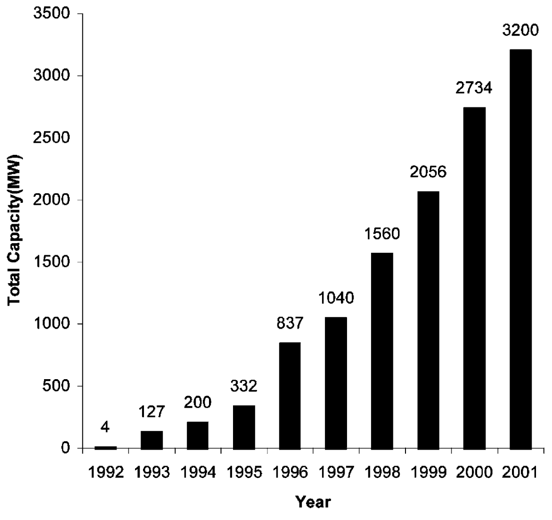


Fig. 1. Last 10-yr improvement of autoproduction [4].

duction centres, as at March 2000, according to the fuel that they use is shown in Table 2 [3]. When the fuels used in cogeneration are examined we can see natural gas, LPG, naphthalene, diesel, coal, fuel oil. Natural gas is the most preferred because it is economic and environmentally friendly. Fuel oil number 6, which maintains its feature as a cheap fuel, is the second choice. However, because it

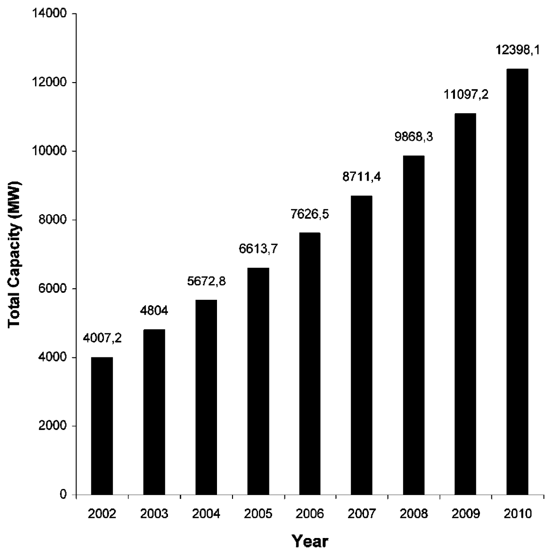


Fig. 2. Estimated improvement of autoproduction between 2002 and 2010.

Table 1
Regional distribution of autoproducers as of March 2000 [2]

Region	Installed capacity (MW)	Share (%)	Generation GWh/yr (in 1999)	Share (%)
Marmara	1265	60.8	6883	63,4
Aegean	291	14.0	1500	13,8
Mediterranean	235	11.3	816	7,5
Central Anatolia	153	7.4	572	5,3
Black Sea	135	6.5	1077	9,9
Total	2079	100.0	10,848	100

harms the environment, its usage without special precautions is not allowed [7]. Turkey prefers natural gas for most of the power plants that it recently added to its established capacity. Turkey's natural gas production meets 2.8% of its need. The demand for natural gas is expected to rise gradually in Turkey due to its industry and power plants. Almost all of the natural gas need of Turkey is imported from Russia. Turkey wants to increase the variety of natural gas sources by adding Egypt, Iran, Iraq, Russia and Turkmenistan, into its supplier countries [8]. Because it is environmental friendly, easy to use, has profitable burning, and can be supplied continuously, LPG is used safely in business enterprises which need energy. When their current prices are examined, it is seen that LPG and diesel are far removed from their features of being the main fuel sources. When emission is examined (CO_2, SO_2, NO_x values), LPG, which can be supplied throughout Turkey, is a clean and environmental friendly fuel. LPG is expected to be an alternative to natural gas in cogeneration systems, and its usage is expected to be widespread [7].

Sectoral scattering of autoproduction systems are shown in Table 3. In accordance with Table 3, the textile, chemical industry, iron and steel sectors, form 53%

Table 2
Autoproducers by fuel types as of March 2000 [3]

Sector	Installed capacity (MW_e)	Share (%)	Generation GWh/yr (in1999)	Share (%)
Natural gas	1335	64.2	7264	67.0
Fuel oil	455	21.9	1895	17.5
Renewables	93	4.5	838	7.7
Naphta	63	3.0	237	2.2
LPG	63	3.0	343	3.2
Hard coal	35	1.7	182	1.7
Hydro	19	0.9	20	0.2
Diesel oil	10	0.5	64	0.6
Lignite	6	0.3	5	0.0
Total	2079	100.0	10,848	100.0

Table 3
Sectoral distribution of autoproducers as of March 2000 [3]

Sector	Installed capacity (MW_e)	Share (%)	Generation (GWh/yr) (in 1999)	Share (%)
Textile	415.2	20.0	1688.3	15.6
Chemicals	341.7	16.4	2494.1	23.0
Iron & steel	338.0	16.3	1771.7	16.3
Machinery	166.3	8.0	713.4	6.6
Petrochemicals	148.0	7.1	813.3	7.5
Organized industrial zones.	135.2	6.05	716.1	6.6
Metal	134.5	6.5	993.5	9.2
Paper	113.3	5.4	403.6	3.7
Glass	52.0	2.5	371.6	3.4
Mining	49.2	2.4	161.6	1.5
Tyre & rubber	43.8	2.1	211.5	1.9
Cement	39.6	1.9	130.1	1.2
Food	38.5	1.9	99.4	0.9
Ceramics	27.5	1.3	187.9	1.7
Wood	9.7	0.5	26.2	0.2
Fertilizer	9.4	0.5	5.2	0.0
Various	7.7	0.4	38.3	0.4
Utility	7.1	0.3	17.9	0.2
Plastics	1.5	0.1	4.4	0.0
Total	2079.0	100.0	10,848.0	100.0

of total capacity. While in 1999, the chemical industry, iron and steel sectors had more built up power shares than the textile industry.Currently, the textile sector leads with 20% of total capacity. That is to say, most of the autoproduction systems meet their need (especially heat).

4. Results and Discussions

Turkey is heavily dependent on the import of primary energy sources from abroad. It is heavily dependent on imported oil and gas. This trend is likely to continue in the near future. Turkey's total primary energy production demand will reach 98 Mtoe in 2001 and 308 Mtoe in 2020. In Turkey, the import of primary energy will reach 226 Mtoe and the production of primary energy will increase 81 Mtoe in 2020 [9]. Legal regulations related to autoproduction systems, which provide both private and state sectors' participation and contribution in building energy infrastructure, have been quite effective. In 2001, 19 billion kWh of electrical energy and 8 billion kWh of heat energy were produced by autoproduction systems in Turkey. When this quantity was compared to conventional systems, it is seen that 1500000 TEP (ton equal petroleum) of fuel were saved. It is providing energy productivity with the help of autoproduction energy production facilities.

This condition will help reduce the energy cost of industrial products and increase the competing force of the industrial sector in foreign markets. With the prevalence of cogeneration applications that would be built under autoproduction licence throughout the country, flexibility will be gained in meeting the increasing demand for energy. The cost of electricity produced by cogeneration systems is much lower than that produced by conventional systems. With these systems, the loss faced in energy distribution costs and transmission lines will be prevented.

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